Neoraja iberica n. sp., a new species of pygmy skate (Elasmobranchii, Rajidae) from the southern upper slope of the Iberian Peninsula (Eastern North Atlantic)

by

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ABSTRACT. - *Neoraja iberica* n. sp. is described from the Portuguese and Spanish sector of the Iberian Peninsula south coast slope, based on a series of 50 type specimens representing all sizes of both sexes. This pygmy skate species was found with a maximum total length of 316 mm for females and 327 mm for males. The smallest specimens were a 55 mm neonate female and a 67 mm TL male. This new species is easily distinguished externally from four named congeners *N. stehmanni, N. caerulea, N. africana* and *N. carolinensis* by: upper side ochre to medium greyish-brown and dark greyish in ground colour with a lively ornamentation in smaller specimens of dark brown dots and spots all over disc and posterior pelvic lobes to the extreme margins, plus frequently a few pairs of whitish spots and dots on inner pectorals; 7-8 blackish cross-bars or asymmetrically paired saddle blotches along tail, which pattern fades with growth and becomes reduced in adults to a few pairs of larger dark, pale edged spots, plus mostly 1-2 pairs of the whitish dots, and cross-bars or saddle blotches along tail become less distinct; underside of disc, pelvic-fins and tail white, at most a faint greyish margin to posterior disc and pelvic lobes, but occasionally a cloud of merging brownish spots appears on each pectoral centre. A mature male specimen in poor condition of about 260 mm TL from the southern Bay of Biscay, originally identified by Vaillant (1888) as *Raja fullonica* Linnaeus 1758, is now reallocated to *Neoraja*, based mainly on features of its nearly skeletonised claspers. The similar patchy and limited distributional range of each species all along the Eastern Atlantic from off South Africa to off Scotland is briefly discussed, with four or five species occurring in the Eastern and only one species in the NW Atlantic.

RÉSUMÉ. - *Neoraja iberica* sp. nov., une nouvelle espèce de raie (Elasmobranchii, Rajidae) de la pente continentale méridionale de la péninsule Ibérique (Atlantique nord-est).

Neoraja iberica sp. nov. est décrite des secteurs portugais et espagnol de la côte méridionale de la péninsule Ibérique, à partir d'une série de 50 spécimens-types, représentant toutes les tailles des deux sexes. Les plus grands specimens étaient une femelle de 316 mm et un mâle de 327 mm LT. Les plus petits spécimens étaient un nouveau-né femelle de 55 mm LT et un mâle de 67 mm LT. Cette nouvelle espèce se distingue aisément de ses congénères *N. stehmanni, N. caerulea, N. africana* et *N. carolinensis* par sa coloration générale : la face dorsale du disque est ocre à gris brun moyen, ou bien gris sombre. Chez les plus petits spécimens, l'ornementation est constituée de points et de taches brunes sur tout le disque et les lobes postérieurs des pelviennes jusqu'aux bords extrêmes; de plus, il y a souvent quelques paires de points et de taches blanchâtres au centre des pectorales, 7-8 barres transversales noirâtres ou des paires de taches asymétriques à cheval sur la queue, qui s'estompent avec la croissance et qui sont réduites chez les adultes à quelques paires de grandes taches sombres, bordées d'une auréole claire. Il y a souvent également 1-2 paires de points blanchâtres et des bandes transversales ou des taches en selle sur la queue qui deviennent moins distinctes chez les adultes. La partie ventrale du disque, des pelviennes et de la queue est blanche, avec tout au plus une faible bande grisâtre le long des bords postérieurs du disque et des lobes pelviens ; une zone de taches brunâtres apparaît occasionnellement au centre des pectorales. Un mâle adulte d'environ 260 mm LT provenant du sud du golfe de Gascogne, décrit par Vaillant (1888) comme *Raja fullonica* L., 1758, est maintenant assigné au genre *Neoraja* d'après les caractères du squelette interne des ptérygopodes qui sont presque totalement décharnés du fait du mauvais état de conservation du spécimen. Les distributions similaires, en taches et très limitées, des espèces du genre *Neoraja* le long des côtes atlantiques est, de l'Afrique du Sud à l'Ecosse, est discutée; le genre *Neoraja* comprenant quatre ou cinq espèces en Atlantique est et une seule en Atlantique nord-ouest.

Key words. - Rajidae - *Neoraja iberica* - Skates - ANE - Iberian Peninsula - Gulf of Cadiz - New species.

Bigelow and Schroeder (1948) established the genus *Breviraja* for soft-snouted pygmy skates first found in the Western North Atlantic and assigned their new species *B. colesi* (generotype) and *B. plutonia* (Garman, 1881) to this genus. These authors diagnosed their genus as "Rajidae with a rostral cartilage, but with the latter falling consider-

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ably short of the extremities of the anterior rays of the pectorals and hence short of the tip of the snout; the anterior pectoral rays of the two sides are either close together anteriorly or are farther separated. Characters otherwise as in *Raja*." Six more Western North Atlantic species were subsequently described by Bigelow and Schroeder (1950): *B. cubensis*, *B. atripinna*, *B. sinusmexicanus*, *B. spinosa*, *B. yucatanensis*; and Bigelow and Schroeder (1962): *B. ishiyamai*. Other authors added to this number by describing or assigning further species from other ocean localities to *Breviraja*, based primarily on the soft-snouted rostral condition (e.g., Ishiyama 1958, 1967; Bigelow and Schroeder, 1965; Forster, 1967; Krefft, 1968a), although in external appearance and size most differed considerably from the eight species initially assigned to the genus *Breviraja* by Bigelow and Schroeder (*loc. cit.*).

Ishiyama and Hubbs (1968) compared rostral cartilages and claspers of *Breviraja colesi* with those of soft-snouted Western North Pacific skates described by Ishiyama (1958, 1967) and found considerable differences. Consequently, they rediagnosed *Breviraja* based on its type species *B. colesi* and assigned all species, other than the original eight from the Western North Atlantic, to the genus *Bathyraja* Ishiyama, 1958 by elevating it from subgeneric rank *Breviraja* (*Bathyraja*) to a defined genus. Following this revision, various authors reallocated many species previously assigned to *Breviraja* to *Bathyraja* (e.g. Stehmann, 1970, 1978; Hulley, 1970; Menni, 1972).

Based on the revised diagnosis of *Breviraja* by Ishiyama and Hubbs (1968), further species were described mainly from the Eastern Atlantic: *B. stehmanni* Hulley, 1972, *B. caerulea* Stehmann, 1976b. Stehmann (1976a) also reallocated two Indian Ocean species of *Raja* to *Breviraja*, namely *B. mamillidens* (Alcock, 1889) and *B. sibogae* (Weber, 1913) and commented on a third unnamed one Weber (1913) had collected and assigned to *Raja mamillidens* Alcock, 1889. McEachran and Compagno (1982) analysed and disentangled the interrelationships of and within *Breviraja* with a detailed revision of the 11-12 species resulting in: *Breviraja* Bigelow and Schroeder, 1948 was restricted to two species *B. colesi* and *B. spinosa*, a new genus *Neoraja* was erected with two subgenera *Neoraja* and *Fenestraja*; to the former subgenus were assigned *B. stehmanni*, *B. caerulea* and an unnamed third species, to the latter subgenus the majority of species, i.e. *sinusmexicanus, sibogae, ishiyamai, cubensis, plutonia, atripinna*, and finally was *B. yucatanensis* reallocated to *Raja*.

Three more Western Atlantic species of *Breviraja* were newly described after the genus revision by McEachran and Compagno (1982): *B. claramaculata* McEachran and Matheson, 1985, *B. nigriventralis* McEachran and Matheson, 1985, *B. mouldi* McEachran and Matheson, 1995. A fourth one, *B. marklei* McEachran and Miyake, 1987 from off Nova Scotia, however, is a junior synonym of *Rajella fyllae* (Lütken, 1888).

Appearance of the McEachran and Compagno (1982) revision had overlapped with the manuscript submission by Stehmann and Séret (1983) describing a third Eastern Atlantic species, *Breviraja africana*. McEachran and Stehmann (1984) thus described a fourth species already as *Neoraja carolinensis* from the Western North Atlantic and placed *B. africana* also in *Neoraja* presently comprising three Eastern and only one Western North Atlantic species.

McEachran and Dunn (1998), after a phylogenetic analysis of relevant character complexes, finally elevated all former rajoid subgenera of several genera to generic rank and rediagnosed the genus *Neoraja* for mainly features like: without oronasal pits; individual thorns on nape/shoulder regions, no thorn triangle; median thorns along trunk and tail in a single row; anterior pelvic lobes about 3/4 of length of posterior lobes; tail length distinctly more than 60% of TL; caudal fin with hypochordal lobe; cranium without nasobasal fenestrae, with narrow anterior fontanelle, and feeble rostral shaft almost reaching rostral node; low number of trunk vertebrae, less than 29; clasper tip with external components terminal bridge and dike; clasper skeleton with large dorsal terminal 1 and ventral terminal cartilages which firmly fused distally around axial; accessory terminal 1 cartilage U-shaped and with distal extension.

The present paper describes the fifth species of *Neoraja* and the fourth one from the Eastern Atlantic, based on 50 specimens covering both sexes and all sizes. Stehmann and Séret (1983:921) had discussed this Iberian species briefly in their interspecific comparison of *B. africana*.

MATERIAL AND METHODS

Institutional acronyms follow Leviton *et al.* (1985).

External morphometric measurements were taken from 70% ethanol preserved specimens by dial callipers to 1/10 of a millimetre largely following the scheme of Bigelow and Schroeder (1953), i.e. between perpendiculars, to allow direct comparison with previously described congeners, except for: ventral head length after Ishiyama (1958); nasal curtain and head length (= dorsal HL) measurements after Hubbs and Ishiyama (1968), length of anterior and posterior pelvic lobes according to Stehmann (1985), which all also taken between perpendiculars. Skeletal morphometric measurements of cranium and scapulocoracoid follow McEachran and Compagno (1979) and vertebral counts Krefft (1968b). Skeletal meristics were counted from soft X-rays films: for pectoral radials, the anteriormost propterygium was not counted but only the first laterally attached real radial, as well as on the last metapterygium the last laterally attached one was counted as a radial but not radial-like

extension (at times bifurcated) at the rear surface. For pelvic fin (V) radial counts, the thick first one was counted as the first one.

The Portuguese samples were taken during M.E. Costa's research period for her PhD under the auspices of the projects DISCALG (Borges *et al*., 2000), BYDISCARD (Borges *et al*., 2002) and BIOFISH (Borges *et al*., 2007) on board chartered commercial shrimp trawlers using nets specified only by their overall length, with mesh size between 55 and 59 mm.

Two damaged Portuguese paratype specimens, juv. female (ZMH 25427) and juv. male (ZMH 25428), were used for skeletal dissections of crania, scapulocoracoids and pelvic girdles and these elements kept at the Zoological Museum Hamburg University. Alcian blue staining and dissections from underside of snout of another specimen (ZMH 25435) were done to confirm shape of rostral node and its long appendices. In addition, left scapulocoracoids of two more female and male paratypes (MNHN 2007-0124 and MNHN 2007-0125) were dissected in order to confirm variation range found in the two ZMH paratypes specified above and for confirming sexual dimorphism. The holotype male was not at all dissected, only its opened glans clasper with external components is illustrated here, and clasper skeleton was dissected of the mature male paratype ZMH 25429.

Photographs of the original Spanish specimens (1982) of Málaga University, of all new Portuguese and Spanish specimens were taken by the senior author, who also prepared the drawings of figures 5 and 8-12 and 14, and ZMH ichthyology staff assisted with radiographs of all specimens. The map of figure 1 was prepared by João Sendão of the CCMAR, University of the Algarve, Faro. The 50 type specimens have been split and distributed to various European and an U.S. collection as specified in the list of material.

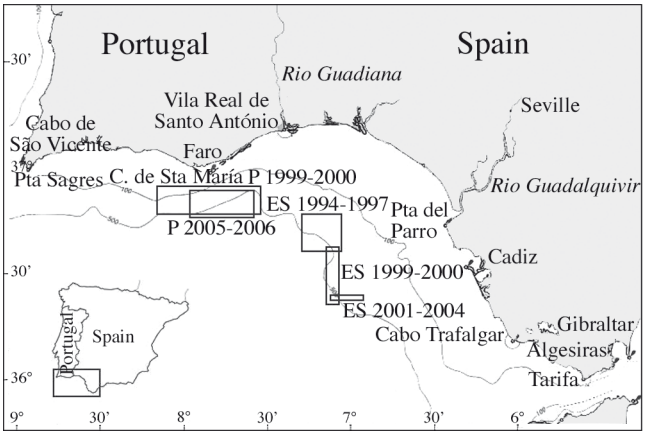

Figure 1. - Atlantic south coast of the Iberian Peninsula from Strait of Gibraltar to Cabo de São Vicente, with 100 m and 500 m continental slope isobathic lines. Rectangles indicate capture areas of the Portuguese *Neoraja iberica* samples off Faro during the 1999-2000 and 2005-2006 project periods and the Spanish samples within the Gulf of Cadiz during 1994-1997, 1999-2000 and 2001-2004 surveys. *[Côte atlantique méridionale de la péninsule Ibérique depuis le détroit de Gibraltar jusqu'au cap Saint Vincent, avec les isobathes 100 et 500 m de la pente continentale. Les rectangles indiquent les zones de capture des exemplaires portugais de* N. iberica *au large de Faro, au cours des campagnes de 1999-2000 et de 2005-2006, et des exemplaires espagnols dans le golfe de Cadix au cours des campagnes de 1994-1997, 1999-2000 et 2001-2004.]*

NEORAJA IBERICA N. SP.

(Figs 1-14; Tabs I-V)

Proposed vernacular names: Iberian pygmy skate (En), raie pygmée ibérique (F), raya pigmea ibérica (ES), raia pigméia ibérica (P), Iberischer Zwergrochen (De).

Material examined

Holotype. - MB 4869, mature male 322 mm TL; FV 'Porto Amboim', trawl #1, 3. Jun. 2006; 36º50.7'-36º54.3' N, 07º44.8'-07º39.1' W at 558-531 m depth; 23 m crustacean trawl; collectors Patrícia Calixto and Gonçalo Carvalho.

49 paratypes. - Portuguese specimens: MB 4870; adol. female 253 mm TL; FV 'Crustáceo', trawl #2, 8 Jun. 2000; 36°47.8'-36°50.5' N, 07°39.6'-07°48.5' W at 520-620 m; 23.6 m crustacean trawl; collectors M. Esmeralda Costa and Sónia Olim. - MB 4871; juv. male 249 mm TL; FV 'Aurora Boreal', trawl #1, 8 May 2005; 36º48.5' N-07º59.1' W (start position only) at 538 m depth (mean); 26.5 m crustacean trawl; collectors Inês Figueiredo and Jorge Encarnação. - MB 4872; juv. male 244 mm TL; FV 'Aurora Boreal', trawl #1, 9 May 2005; 36º46.9' N-08º10.3' W (start position only) at 531-540 m depth; 26.5 m crustacean trawl, collectors Inês Figueiredo and Jorge Encarnação - MB 4873a-d; adol. female 235 mm (a), juv. female 129 mm (b), juv. male 200 mm (c), juv. male 221 mm TL (d); FV 'Porto Amboim'; trawl #2, 29 May 2006; 36º49.8'-36º51.0' N, 07º39.4'-07º35.0' W; at 529-512 m depth; 23 m crustacean trawl; collectors Patrícia Calixto and Gonçalo Carvalho. - MB 4874, mature female 314 mm TL; FV 'Porto Amboim'; trawl #1, 3 Jun. 2006; 36º50.7'-36º54.3' N, 07º44.8'-07º39.1' W at 558-531 m depth; 23 m crustacean trawl; collectors Patrícia Calixto and Gonçalo Carvalho. - MNCN 259.151; juv. male 216 mm TL; FV 'João Pinto', trawl not numbered, 1 May 1999; no precise locality data, off Faro; 24.5 m crustacean trawl. - MNCN 259.152; juv. female 192 mm TL; data as for MB 4871. - MNCN 259.153; juv. male 167 mm TL; FV 'Porto Amboim', trawl #3, 25 Sep. 2005; 36º57.3'-36º54.1' N, 07º34.3'-07º46.2' W at 172-403 m depth; 23 m crustacean trawl, collectors Gonçalo Carvalho and Jorge Encarnação. - MNHN 2007-0013; juv. female 228 mm TL; FV 'Gamba', trawl #3, 11 May 1999; 36°53.1'-36°45.7' N, 07°42.3'-07°54.2' W at 172-670 m; 30 m crustacean trawl; collectors M. Esmeralda Costa and Sónia Olim. - MNHN 2007-0014; juv. male 270 mm TL; data as for MNCN 259.151 - MNHN 2007-0015; juv. female 239 mm TL; data as for MB 4870. - MNHN 2007-0016; juv. male 183 mm TL; FV 'Aurora Boreal', trawl #1, 10 May 2005; 36º46.9' N-08º10.2' W (start position only) at 530 m depth (mean); 26.5 m crustacean trawl, collectors Inês Figueiredo and Jorge Encarnação. - TCWC 13204.01; juv. female 262 mm TL; data as for MB 4870. - ZMH 25427; juv. female 230 mm TL; FV 'Crustáceo', trawl #1, 8 Jun. 2000; off Faro on the slope, no precise locality data taken) (skeletal parts only), 23

Figure 2. - *Neoraja iberica* n. sp., 322 mm TL mature male holotype, MB 4869, in total dorsal (**A**) and ventral (**B**) views. *[Vue dorsale (**A**) et vue ventrale (**B**).]*

m crustacean trawl; collectors M. Esmeralda Costa and Sónia Olim. - ZMH 25428; juv. male, 252 mm TL (skeletal parts only); data as for MNCN 259.151. - ZMH 25429; mature male 318 mm TL; FV 'Aurora Boreal', trawl #1, 8 May 2005; 36º48.5' N -07º59.1' W (start position only) at 538 m depth (mean); 26.5 m crustacean trawl; collectors Inês Figueiredo and Jorge Encarnação. - ZMH 25430, immature female 200 mm TL; data as for MB 4873a-d. - ZMH 25431, immature female 191 mm TL; data as for MB 4873a-d. - ZMH 25432, immature male 142 mm TL; data as for MB 4873a-d. - ZMH 25433, immature male 209 mm TL; data as for MB 4873a-d. - ZMH 25434, mature female 316 mm TL; data as for MB 4874.

Initial Spanish specimens. - 7 immature females (170.5-206.4 mm TL) and 3 immature males (184.2-187.5 mm TL) taken by commercial trawlers from the Isla Cristina, Gulf of Cadiz, fishing fleet in 1982 by otter trawl on fine and coarse sand bottom within an area delimited by approximately 36°30-45' N-07°05-20' W and within a depth range of about 450-600 m; collector J. Baro. - MB 4875, juv. female 170.5 mm TL. - MB 4876, juv. female 170.5 mm TL. - MNCN 259.154, juv. female 202.6 mm TL. - MNCN 259.155, juv. female 206.4 mm TL. - MNCN 259.156, juv. female 192.7 mm TL. - MNCN 259.157, juv. male 187.5 mm TL. - MNHN 2007-0124, juv. female 202 mm TL. - MNHN 2007-0125, juv. male 186.4 mm TL. - ZMH 25435, juv. fem. 203.4 mm TL. - ZMH 25436, juv. male 184.2 mm TL.

New Spanish specimens. - From 1994-2004, collector J. Baro. - MB 4877, mature male 295 mm TL; RV 'Cornide de Saavedra' cr. ARSA 0302, haul 19, 2 Mar. 2002; 36°21.25' N-06°54.75' W, 522 m; 'baka' bottom trawl. - MB 4878, juv. female 112 mm TL; RV 'CdS' cr. ARSA 0301, haul 35, 8 Mar. 2001; 36°21.40' N-07°07.60' W, 679 m; 'baka' bottom trawl. - MNCN 259.158, mature female 294 mm; MNCN 259.159, adolescent male 278 mm TL; RV 'CdS' cr. ARSA 0394, haul 18, 6 Mar. 1994; 36°36.62' N-07°03.87' W, 494 m; 'baka' bottom trawl. - MNCN 259.160, neonate female 55

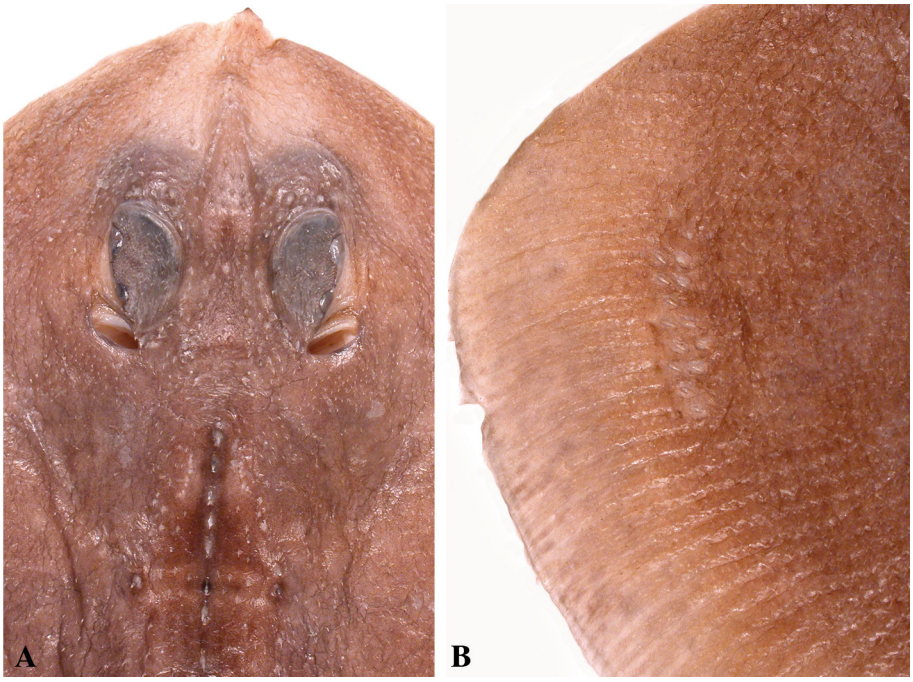

Figure 3. - *Neoraja iberica* n. sp., 322 mm TL mature male holotype, MB 4869, close ups of head dorsally (**A**) and of left wing tip with alar thorn field (**B**). *[Vue détaillée dorsale de la tête (**A**) et du groupe d'épines alaires sur le bord de la pectorale gauche (**B**).]*

mm, MNCN 259.161, juv. female 97 mm; MNCN 259.162, juv. male 202 mm TL; RV 'CdS' cr. ARSA 197, haul 12, 22 Feb. 1997; 36°47.55' N-07°16.80' W, 484 m; 'baka' bottom trawl. - MNCN 259.163, mature male 315 mm TL; RV 'CdS' cr. ARSA 1199, haul 8, 5 Nov. 1999; 36°37.89' N-07°04.26' W, 496 m; 'baka' bottom trawl. - MNCN 259.164, mature male 327 mm TL; RV 'CdS' cr. CALIMA 00, haul 25, 16 Nov. 2000; 36°42.61' N-07°06.89' W, 478 m; 'baka' bottom trawl. - NMHN 2007-0017, mature male 298 mm TL; data as for MB 4877. - MNHN 2007-0018, juv. female 157 mm TL; RV 'CdS' cr. ARSA 0304, haul 37, 13 Mar. 2004; 36°21.35' N-06°55.52' W, 522 m; 'baka' bottom trawl. - MNHN 2007-0019, mature female 299 mm, data as for MNHN 2007-0018 - TCWC 13205.01, mature male 312 mm TL, data as for MNHN 2007-0018. - ZMH 25437, mature male 305 mm TL, data as for MB 4877. - ZMH 25438, juv. male 67 mm TL, data as for MB 4878.

Diagnosis

Disc inverse heart-shaped, with short, triangular projection at snout tip; tail length about 62% (mean) of TL; lateral folds only along posterior half or 1/3 of tail length; caudal fin with hypocordal lobe; anterior pelvic lobes about 3/4 of length of posterior lobes; ochre to greyish-brown or dark greyish disc and posterior pelvic lobes distinctly ornamented dorsally by many dark brown spots and dots and frequently a few paired whitish spots in small and half-grown specimens, all often reduced in larger sized specimens to few pairs of larger symmetrically placed brown, pale edged spots, plus 1-2 pairs of pale spots or dots; tail with 7-8 more or less distinct dark cross-bars or asymmetrically placed saddle blotches; underside of disc and tail white, at most pale greyish margin to pectoral corners and posterior margins, and occasionally a cloud of merged pale brownish spots centrally on each pectoral. Upper side of disc, posterior pelvic lobes and back of tail totally and densely covered with fine dermal denticles, sides of tail with several rows of hooked thornlets. Individual thorns on nape/shoulder regions, no thorn triangle; median thorns along trunk and tail in a single row almost disappearing in posterior half or 1/3 of tail. Dorsal thorns appear irregularly mixed in various stages of development, shape and size in all their locations, resulting particularly in midline thorns (about 60 posterior to shoulder girdle to D1) being set at irregular interspaces. Underside totally smooth, except for extreme edges of tail set with erect dermal denticles which in dorsal and caudal fin section are embedded. Cranium without nasobasal fenestrae, with narrow anterior fontanelle and delicate, thin rostral shaft almost reaching rostral node. Low number of less than 29 trunk vertebrae. Glans clasper with external components terminal bridge, dike and newly defined component ribbon; clasper skeleton with large dorsal terminal 1 and ventral terminal cartilages which firmly fused distally around axial; accessory terminal 1 cartilage U-shaped and with distal extension.

Description of the holotype (Figs 2-5, 11A, 13A)

Detailed morphometric measurements and meristics given in tables I-III and V.

External morphology (Figs 2-4): disc inverse almost heart-shaped, 1.2 times as broad as long, with axis of maximum disc width at about 60% of disc length somewhat posterior to level of shoulder girdle. Anterior disc margins strongly undulated, i.e. concave opposite short projection at snout tip, strongly convex at snout sides to level with eyes, strongly

Figure 4. - *Neoraja iberica* n. sp., 322 mm TL mature male holotype, MB 4869, close ups of mouth/nasal region (**A**), pelvic fins and claspers dorsally (**B**) and enlarged tail section dorsally (**C**) showing transition from regular median thorn row to its becoming irregular and almost disappearing in posterior half of tail. *[Vue détaillée de la région bucco-nasale (**A**), vue dorsale des nageoires pelviennes et des ptérygopodes (**B**), et de la section élargie de la queue (**C**) montrant la transition entre la partie régulière de la rangée médiane d'épines et la partie irrégulière, jusqu'à sa disparition dans la moitié postérieure de la queue.]*

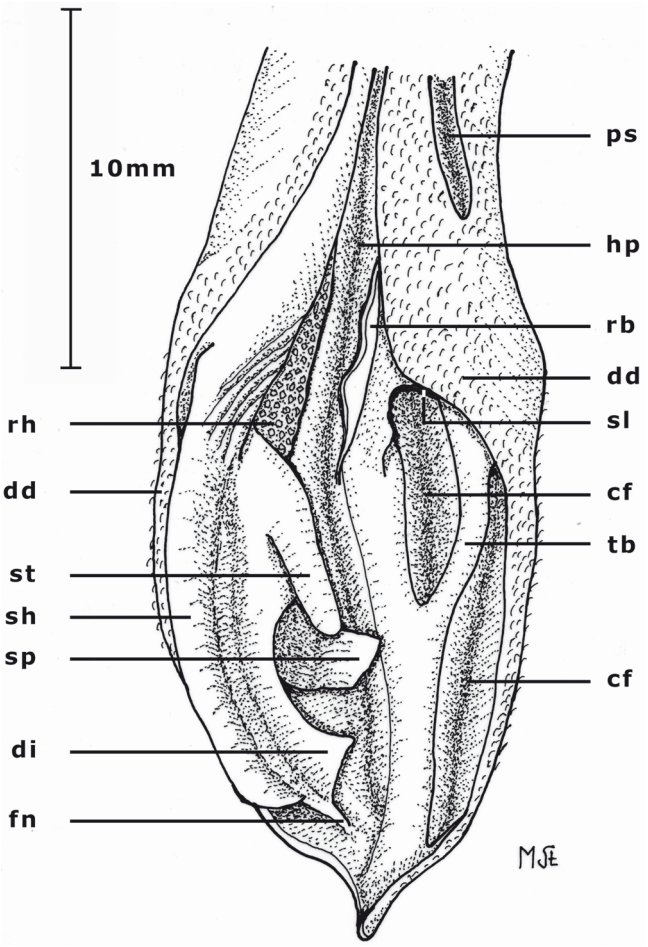

Figure 5. - *Neoraja iberica* n. sp., 322 mm TL mature male holotype, MB 4869, opened left glans clasper showing components and coverage with dermal denticles. Abbreviations: cf = cleft, dd = dermal denticles, di = dike, fn = funnel, hp = hypopyle, ps = pseudosiphon, rb = ribbon, rh = rhipidion, sh = shield, sp = spike, st = sentinel, sl = slit, tb = terminal bridge. *[Extrémité ouverte du ptérygopode gauche montrant les constituants et le revêtement de denticules cutanés. Abréviations: cf = clef, dd = denticules cutanés, di = dike, fn = funnel, hp = hypopyle, ps = pseudosiphon, rb = ribbon, rh = rhipidion, sh = shield, sp = spike, st = sentinel, sl = slit, tb = terminal bridge.]*

concave to level of spiracles and nape, and convex again toward to the broadly rounded outer corners continuous with the evenly convex posterior disc margins. Inner pectoral corners narrowly rounded, with pectoral axils deeply incised to origin of anterior pelvic lobes. Snout bluntly rounded, snout angle 122°, with short triangular projection at tip. Snout very short, preorbital length 3.1 times the very narrow interorbital width and nearly 6 times in disc width. Orbits large, horizontal diameter 1.8 times the interorbital width and 57% of preorbital snout length. Spiracle length 54% of orbit diameter, interspace between spiracles 2.2 times the interorbital width. Eight pseudobranchial folds in each spiracle. Pelvic fins large, with deep notch separating both lobes. Anterior lobes

Table I. - *Neoraja iberica* n.sp., morphometrics 40 type specimens: holotype in mm and % TL; mature female, small juvenile female and male paratypes as % TL; all 40 types with min-max-mean values % TL. *[Caractères morphométriques des 40 spécimens-types : en mm et en % LT pour l'holotype, en % LT pour les paratypes femelles adultes, et les femelles et mâles juvéniles ; valeurs minimales et maximales en % LT pour l'ensemble des 40 types.]*

Collection Coll. No.	HT	MB 4869	PT-ZMH 25434	PT-MNCN 259 161	PT-ZMH 25438	min.	max.	mean	Notes as values at times for less than 40 spec.
Sex		mat. male	mat. fem. 316 mm TL	juv. fem. 97 mm TL	juv. male 67 mm TL	18 females and 22 males			
	mm	%	%	%	%				
TL, mm	322.0	100.0	100.0	100.0	100.0	55.0	327.0	229.9	mm
Disc, width	170.0	52.8	54.1	49.5	41.8	25.5	55.0	50.4	-
Disc, length	140.0	43.5	44.0	41.2	43.3	36.4	44.6	42.0	-
Snout length, preorbital	28.8	8.9	10.1	9.3	9.4	7.6	10.8	9.0	-
Snout length, preoral	30.4	9.4	10.8	10.0	11.6	7.9	16.6	10.0	-
Snout length, prenasal	21.5	6.7	7.7	8.2	9.0	4.5	9.0	7.1	-
Orbit, horizontal diameter	16.5	5.1	5.1	5.1	6.3	4.3	6.3	5.1	-
Eyeball, horiz. diameter	13.5	4.2	4.4	-	4.8	3.9	5.1	4.4	37 spec.
Interorbital width	9.2	2.9	3.0	4.4	5.2	2.6	5.2	3.2	-
Spiracle length	9.0	2.8	3.3	2.8	3.0	2.3	3.4	2.9	39 spec.
Interspiracular width	20.5	6.4	6.2	7.4	9.3	5.7	9.3	6.5	-
Orbit + spiracle length	18.3	5.7	5.7	6.5	7.5	5.3	7.5	5.9	-
D1, height	7.3	2.3	2.2	-	1.5	0.8	2.3	1.3	36 spec.
D1, base length	18.8	5.8	6.3	5.2	3.7	3.5	6.4	4.9	39 spec.
D2, height	5.8	1.8	2.1	-	1.2	0.6	2.1	1.3	37 spec.
D2, base length	17.2	5.3	4.8	5.3	3.9	3.4	6.5	5.0	39 spec.
Interdorsal space	0.0	0.0	0.0	0.0	0.0	0.0	1.7	0.1	-
C, base length	10.4	3.2	1.8	5.2	2.5	1.3	5.2	2.7	39 spec.
C, height epichordal lobe	1.5	0.5	0.5	-	0.6	0.3	1.2	0.6	36 spec.
C, height hypochordal lobe	0.8	0.2	0.3	-		0.1	0.3	0.2	30 spec.
Tail, postdorsal length	10.4	3.2	1.9	5.2	2.5	1.7	5.2	2.8	39 spec.
Tail, height at V-tips	6.0	1.9	2.2	3.0	2.7	0.5	3.6	2.3	39 spec.
Tail, width at V-tips	10.5	3.3	3.6	3.8	3.3	2.0	4.4	3.4	39 spec.
Tail, height at D1-origin	2.5	0.8	0.9	0.9	1.2	0.7	1.2	0.8	39 spec.
Tail, width at D1-origin	3.4	1.1	1.2	1.2	1.6	0.8	1.6	1.1	39 spec.
Tail, lateral fold length	75.0	23.3	26.7	-		13.8	31.2	23.4	34 spec.
Head length, ventrally	70.3	21.8	22.2	20.6	24.2	8.4	24.2	21.5	39 spec.
Head length, dorsally	50.5	15.7	16.6	16.8	19.0	6.5	19.0	15.8	-
Mouth width	21.9	6.8	6.5	7.0	8.2	6.2	9.3	7.0	-
Internarial width	19.5	6.1	5.9	6.9	6.3	5.4	7.3	6.1	-
Nasal curtain, length	13.5	4.2	4.1	4.0	4.0	3.1	5.5	4.0	37 spec.
Nasal curtain, width each lobe	7.8	2.4	2.2	2.4	3.0	1.8	3.6	2.4	37 spec.
Nasal curtain, space between lobes	10.0	3.1	3.1	3.0	3.1	2.3	3.9	3.2	37 spec.
Gill slit length, 1st	2.7	0.8	1.3	1.5	1.5	0.8	1.6	1.3	39 spec.
Gill slit length, 3rd	3.2	1.0	1.3	1.5	1.9	1.0	1.9	1.3	39 spec.
Gill slit length, 5th	2.5	0.8	1.0	1.3	1.0	0.7	1.3	0.9	38 spec.
Interspace first gill slits	37.4	11.6	12.6	14.4	14.6	10.7	14.6	12.5	-
Interspace fifth gill slits	18.0	5.6	7.4	8.2	9.0	4.1	9.0	6.6	39 spec.
V-length, ant. lobe	39.0	12.1	11.7	10.7	14.3	9.2	14.3	11.1	39 spec.
V-length, post. lobe	60.5	18.8	15.8	11.5	12.5	11.5	18.8	14.7	39 spec.
Clasper, postanus length	67.7	21.0	-	-	6.3	5.7	22.2	12.8	22 spec.
Clasper length	57.3	17.8	-	-	-	2.6	19.7	10.1	21 spec.
Snout tip to mid-anus	119.0	37.0	38.9	36.8	38.1	34.5	40.0	37.6	-
Snout tip to 1st hemal spine	127.0	39.4	41.1	40.0	-	36.9	41.1	39.4	38 spec.
Snout tip to axis max. disc width	84.0	26.1	26.9	24.7	28.4	22.2	28.4	25.3	39 spec.
Mid-anus to D1	153.5	47.7	48.1	50.0	44.0	44.0	51.1	49.1	39 spec.
Mid-anus to D2	171.0	53.1	53.6	55.2	47.8	47.8	56.7	54.0	39 spec.
Mid-anus to tail tip	198.5	61.6	60.3	65.7	61.8	59.6	65.7	61.7	39 spec.

Table II. - *Neoraja iberica* n. sp.: snout angle and meristics of the holotype and 35-37 paratypes as min-max-mean values. *[Angle du museau et caractères méristiques de l'holotype, valeurs minimales, maximales et moyennes pour 35-37 paratypes.]*

	Holotype	min	max	mean	n
Snout angle	122°	119°	145°	132.3°	36
Pseudobranchial folds	8	9	10	9.1	37
Trunk vertebrae Vtr	24	20	27	23.9	37
Predorsal tail vertebrae Vprd	71	67	78	71.5	37
Pectoral radials	64	64	69	65.6	37
Pelvic radials	18	16	20	17.7	35
Upper jaw tooth rows	41	40	52	43.1	37
Lower jaw tooth rows	44	35	48	41.2	35

long and broad, distal third narrowing slightly and with bluntly rounded tip. Posterior lobes elongated, with pointed tip, angular outer margin moderately convex over distal two thirds. Anterior lobe 64.5% of length of posterior lobe. Claspers fully developed, evenly elongated, with sharply pointed tip marked off and relatively short terminal region only little widened (Fig. 4B); postanal clasper length 34% of tail length from mid-vent. Tail very long, slender, gradually tapering toward tip, length nearly 62% of the total length; depressed over entire length but less so in posterior third; lateral folds restricted to posterior third of tail and terminating about mid-postdorsal tail length. Dorsal fins low and elongated, 2.6 times (D1) and 3 times (D2) as long as high, D1 slightly larger than D2, their bases connected by transparent membrane above tail surface, D2 and upper C confluent. Both dorsal fins of similar shape, with long, almost straight anterior margin rising at about 45° and continuous with short, rounded upper margin, with maximum height over posterior third of base length, then sloping a little toward pointed apex widely overhanging origin of either D2 or upper caudal, respectively; rear margin strongly inclined forward. Postdorsal tail section long, 60% of D2 base length, with almost equally high upper C fold ¼ of D2 height; lower C fold shorter and only half height of the upper.

Preoral snout length 1.4 times the mouth width, mouth width 31% of ventral head length, and the latter 3.6 times internarial width. Distance between fifth gill slits 48% of distance between first gill slits, and the latter distance 1.9 times the internarial space. Mouth width 1.1 times the distance between nostrils. Anterior nasal flaps not well developed, cone-shaped, with fine fringes along outer edge. Outer margins of nasal curtain strongly undulated, with triangular lobelet at proximal third, nearly square-shaped apices with angular outer corners and transverse, almost straight rear edges set with coarse, mostly bifurcated fringes; isthmus steeply arched (Fig. 4A). Oronasal pits underneath nasal curtain apices absent. Jaws nearly straight, upper jaw distinctly indented medially, with a median lower jaw protrusion accordingly. Jaw teeth in 41 upper and 37 lower rows, in close set parallel series in outer thirds of band but in quincunx arrangement medially. Individual teeth with rhombic crown bearing short, conical cusp on inner corner in median

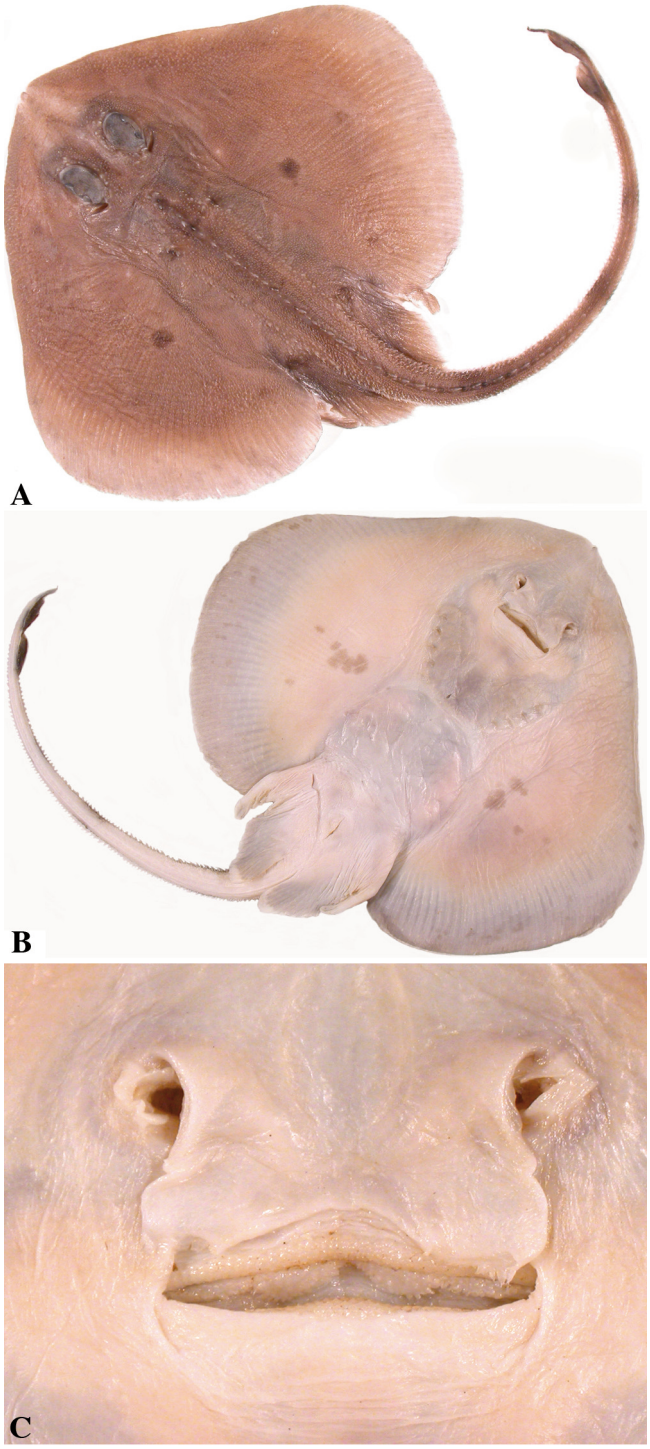

Figure 6. - *Neoraja iberica* n. sp., 316 mm TL mature female paratype, ZMH 25434, in total dorsal (**A**) and ventral (**B**) views, plus enlarged mouth/nasal region (**C**). *[Vue dorsale (**A**), vue ventrale (**B**), et vue détaillée de la région bucco-nasale (**C**).]*

Table III. - *Neoraja iberica* n. sp.: cranial morphometrics of the holotype (X-ray), two dissected juveniles and three more paratypes (X-rays) as per cent of the nasobasal length. *[Caractères morphométriques du crâne de l'holotype (d'après radiographies), de deux paratypes juvéniles disséqués et de trois autres paratypes (d'après radiographies) en % de la longueur nasobasale.]*

Specimen	Holotype MB 4869	ZMH 25427	ZMH 25428*	ZMH 25431	ZMH 25434	ZMH 25429
	X-ray	Dissected	Dissected	X-ray	X-ray	X-ray
Sex and maturity	Mature male	Immature female	Immature male	Immature female	Mature female	Mature male
TL / DW in mm	322 / 170	230 / 118	252 / 127	191 / 98	316 / 171	318 / 168
Cranium TL (x-ray)	178.7	151.3	ca. 144.0	202.0	182.1	172.3
Nasobasal length	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
Max. ethmoidal width	121.7	103.1	98.4	122.7	112.9	120.8
Min. dorsal interorbital width	33.1	30.5	28.0	38.0	30.1	34.6
Min. internasal width	17.1	17.7	16.0	22.7	16.1	17.3
Min. basal plate width	27.0	26.5	24.8	31.3	29.4	28.5
Max. width otic region	73.0	59.3	58.0	70.0	70.6	78.1
Max. width jugular	59.7	58.4	56.0	62.7	60.9	65.4
Rostral shaft length (x-ray)	64.6	51.3	48.0	76.0	71.7	60.8
Rostrum base width	22.1	17.7	17.6	18.7	19.0	21.2
Postnasal length orbit region	30.4	37.2	39.6	30.7	29.0	28.8
Length otic region	30.4	19.5	22.0	29.3	24.4	30.8
Postoccipital length jugal arches	0.0	0.0	0.0	0.0	0.0	0.0
Tip rostrum to tip ant. fontanelle	43.3	24.3	-	55.3	49.5	36.5
Tip rostrum to end ant. fontanelle	91.3	77.9	-	113.3	99.6	84.6
Tip rostrum to tip post. fontanelle	96.2	79.6	-	120.0	106.1	90.0
Tip rostrum to end post. fontanelle	144.1	126.1	-	169.3	154.1	138.5
Tip rostrum to level ant. propterygia	11.4	-	-	6.7	5.7	3.8
Tip rostrum to level max. ethmoidal width	88.2	66.4	-	98.0	93.2	78.8
Tip rostrum to symphysis upper jaw	117.1	91.2	-	133.3	118.3	121.9
Ant. fontanelle length	44.5	40.7	47.2	57.3	50.5	45.8
Ant. fontanelle max. width	20.5	14.6	16.0	22.7	21.9	21.2
Space betw. ant.&post. fontanelles	6.5	8.8	10.8	6.7	7.2	7.7
Post. fontanelle length	49.4	42.5	45.2	52.0	48.7	50.0
Post. fontanelle min. width	1.9	0.4	3.6	4.7	5.0	3.8
Post. font. max. width anteriorly	8.7	4.4	4.8	6.7	7.2	5.8
Post. font. max. width posteriorly	19.0	13.3	12.0	20.0	15.1	15.4
Max. cranial height	-	31.0	28.0	-	-	-
Max. height rostral shaft	-	14.6	14.0	-	-	-
Angle post. edge nasal capsules	79°	80°	80°	70°	71°	75°

rows, with cusp gradually becoming shorter toward mouth corners. Anterior pectoral radials and propterygial elements extended over entire rostral length and almost abutting rostral node at snout tip.

Squamation. - Entire upper disc densely set with fine dermal denticles, except for extreme posterior margins, eyes with fine prickles; denticles coarser, to thornlet size, in malar regions and along sides of trunk. Anterior pelvic lobes smooth, posterior lobes with central patch of fine denticles. Edges of clasper groove over full length densely set with very fine denticles, as well as externally on entire terminal region, and smooth only the proximal half of dorsal clasper stem (Fig. 4B). Dermal denticles sparse directly alongside and between median thorns from nape to 2/3 tail length, but from there rearward more densely set also on back of tail. Laterally along back of tail, a stripe of densely set fine denticles on each side, lower sides of tail densely set with several rows of much larger, hooked thornlets attaining nearly the size of median tail thorns (Figs 4B-C). Both dorsal fins and upper caudal set with fine denticles. Underside of disc and pelvic fins smooth; outer and inner edges and part of terminal surface of claspers set with fine denticles; underside of tail smooth along broad midline, only extreme tail edges with narrow stripe of fine, erect denticles which embedded below dorsal-caudal fin section.

Dorsal thorns appear in various stages of development, shape and size in all areas of their location. The initial ones are evenly cone-shaped, ribbed and on a circular basal plate, with the tip erect and placed centrally; later added or replaced thorns have oval basal plate with low base and long, rearward curving long and pointed tip overhanging rear base; the latter type of thorns also appearing in early development

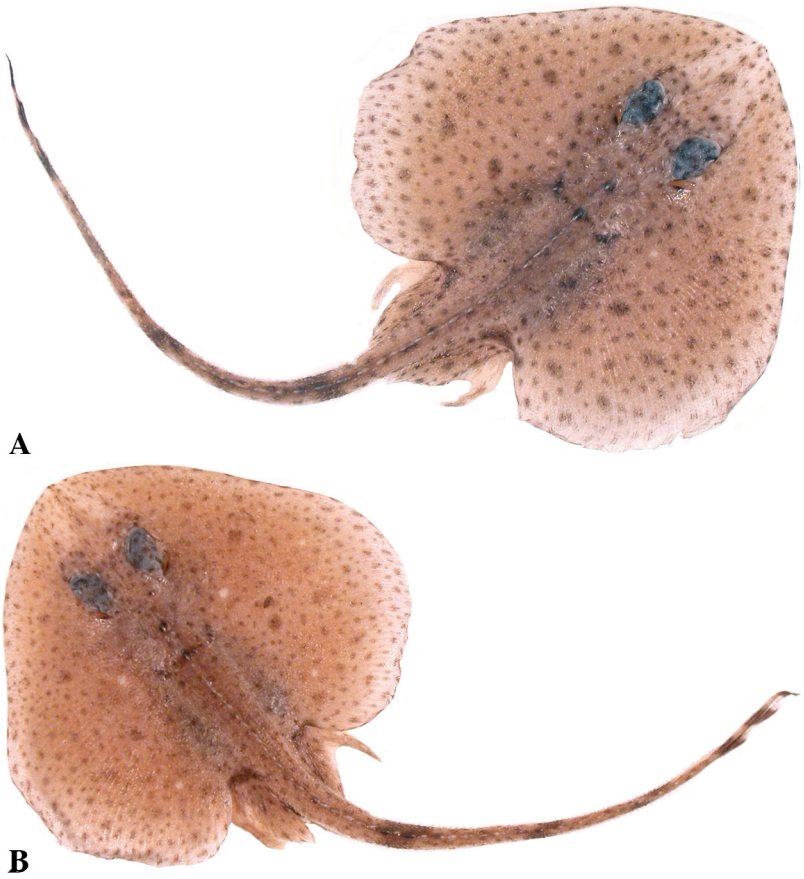

Figure 7. - *Neoraja iberica* n. sp., 129 mm juv. female (MB 4873b) (**A**) and 143 mm TL juv. male (ZMH 25432) (**B**) paratypes showing distinct juvenile dorsal colour pattern. *[Coloration dorsale des paratypes, femelle juvénile de 129 mm LT (**A**) et mâle juvénile de 143 mm LT (**B**).]*

stages, i.e. being whitish, with the low base not yet formed and the long pointed tip being still soft and often embedded under the integument. All three kinds of thorns do appear at orbits, on nape and midline of trunk and tail irregularly mixed resulting in mainly midline thorns set at irregular interspaces. Patch of 7/5 preorbital and 3/2 postorbital thorns on left/right side, respectively, separated by a gap supraorbitally. Pair of small, conical interspiracular thorns at level of occipital joint, only slightly larger than surrounding erect dermal denticles with rearward curving tip. Five median nuchal thorns in a regular line, one in suprascapular position and 1/2 on left/right shoulder (Fig. 3A). Regular mid-row of 12 thorns along back of trunk between shoulder girdle and level of pectoral axils, but these thorns of differing sizes and set at varying interspaces; this median row of thorns continued onto tail with approximately 50 more thorns of different size and shape to near D1, but this row becoming very irregular in posterior half of tail with regard to much smaller size of and much wider spaces between thorns, so that median thorns appear to rather disappear in posterior half of tail length (Fig. 4C). Alar thorns of the permanently erect, hooked, non-erectile type, which form a rather narrow and short stripe inward on left and right wing tip of 2/10 and 2/9 longitudinal/ transverse thorn rows, respectively (Fig. 3B).

Coloration (after preservation in formalin and storage in ethanol) (Figs 2A, 2B). - Upper side medium greyish-brown, slightly darker along midline of body and on tail. Rostral triangle

Specimen	ZMH 25427		ZMH 25428	
Sex and maturity	Immature female		Immature male	
TL / DW in mm	230 / 118		252 / 127	
	left	right	left	right
Max. length	**100.0**	**100.0**	**100.0**	**100.0**
Max. height	86.9	79.6	79.8	80.7
Height at rear corner	61.7	63.9	56.1	57.0
Pre-mesocondyle-length	42.1	43.5	52.6	49.1
Post-mesocondyle-length	49.5	50.9	44.7	48.2
Anterior fenestra height	26.2	25.0	28.1	26.3
Anterior fenestra length	15.0	16.7	7.0	11.4
Postdorsal fenestra height	9.3	10.2	19.3	17.5
Postdorsal fenestra length	13.1	18.5	26.3	22.8
Postventral fenestra height	14.0	15.7	14.9	14.9
Postventral fenestra length	15.0	17.6	27.2	24.6
Total number of postdorsal fenestrae	1	1	1	1
Total number of postventral fenestrae	1	1	1	1

Table IV. - *Neoraja iberica* n. sp.: scapulocoracoid morphometrics as per cent of maximum length of left and right dissected elements of two immature paratypes. *[Caractères morphométriques des scapulocoracoïdes en % de la longueur maximale, mesurés sur les éléments gauches et droits disséqués de deux paratypes immatures.]*

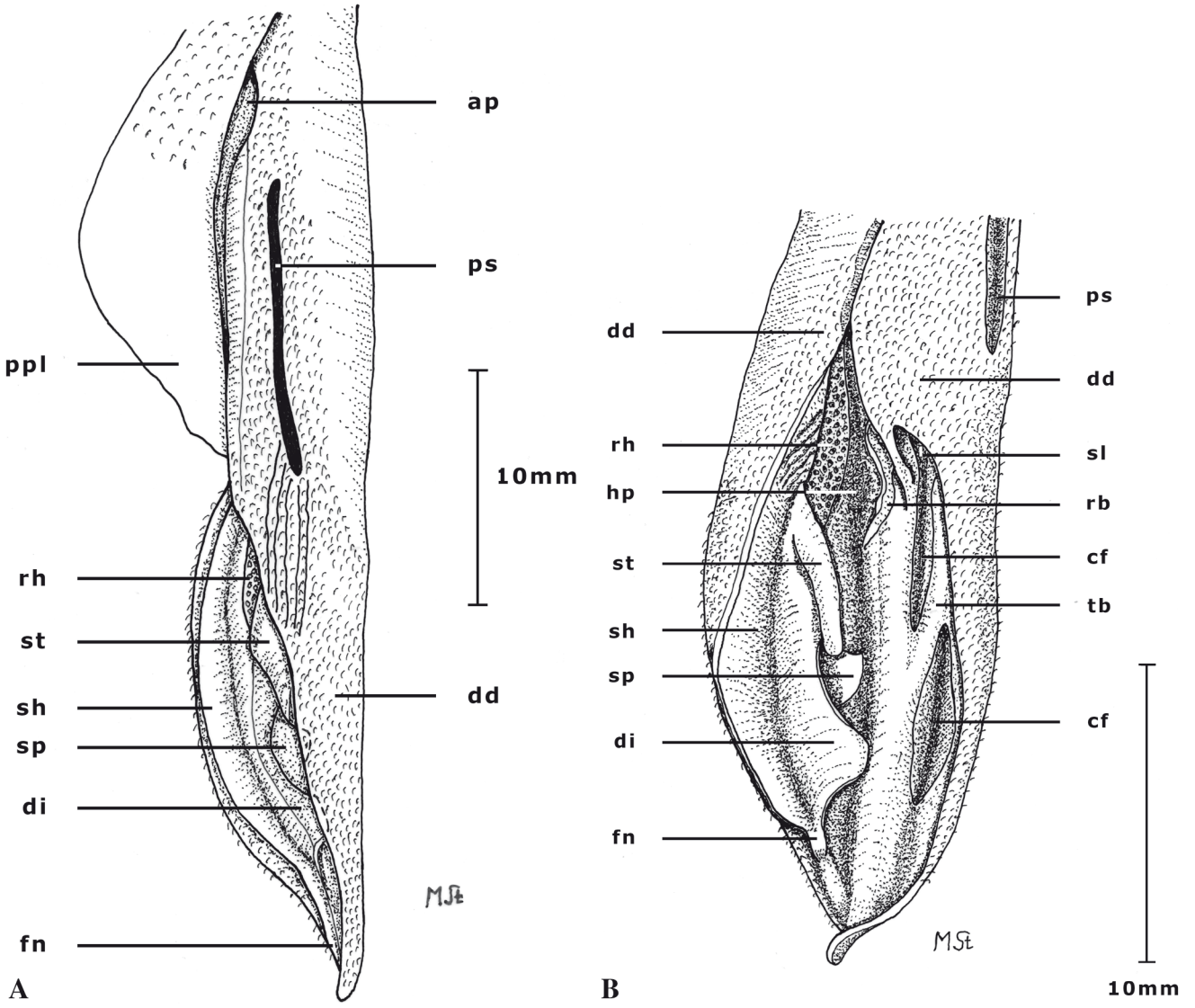

Figure 8. - *Neoraja iberica* n. sp., 318 mm TL mature male paratype ZMH 25429, dorsal view of left clasper showing extension of pseudosiphon and coverage with dermal denticles (**A**), and opened left glans clasper (**B**). Abbreviations as in Fig. 5, and ap = apopyle, ppl = posterior pelvic lobe. *[Vue dorsale du ptérygopode gauche montrant l'extension du pseudosiphon et les denticules cutanés (**A**), et l'extrémité (glans) ouverte du ptérygopode gauche (**B**). Abréviations : voir figure 5, et : ap = apopyle, ppl = lobe pelvien postérieur.]*

semitransparent pale whitish, with rostrum marked off brown. Eyes dusky bluish, broad margins of outer corners and posterior disc semitransparent lighter. Two pairs of circular dark brown spots with pale outer ring on inner pectorals, anterior pair smaller and level with anterior nape, posterior pair larger and level with anterior trunk. Anterior pelvic lobes as disc, with outer margin white only in basal half, whereas inner margin totally edged white; posterior lobes as disc, with white blotch at axils between tail and claspers and narrow pale outer edge. Dorsal side of claspers greyish-brown somewhat darker than disc, except for proximal inner half being paler brown, and also outer edge of the ventral lobe dark brown along clasper groove and its broader terminal region. About seven indistinct dark cross-bars along tail length, with last three through D1, D2 and C respectively, marking the three fins dusky. Lateral tail folds nearly transparent, only at dorsal and caudal fins partly dark. Underside milky-white, with short projection at snout tip brown, broad pale greyish margin to outer corners and posterior pectorals, speckled with pale brown spots, as well as outer margin posterior pelvic lobes. Cloud of largely merged pale brown spots on each pectoral centre. Claspers white, with some brown encroaching from dorsal side at terminal outer margin. Underside of tail only in posterior half irregularly coloured with few pale brown spots at edges, and extreme tail tip dusky. Mouth cavity white.

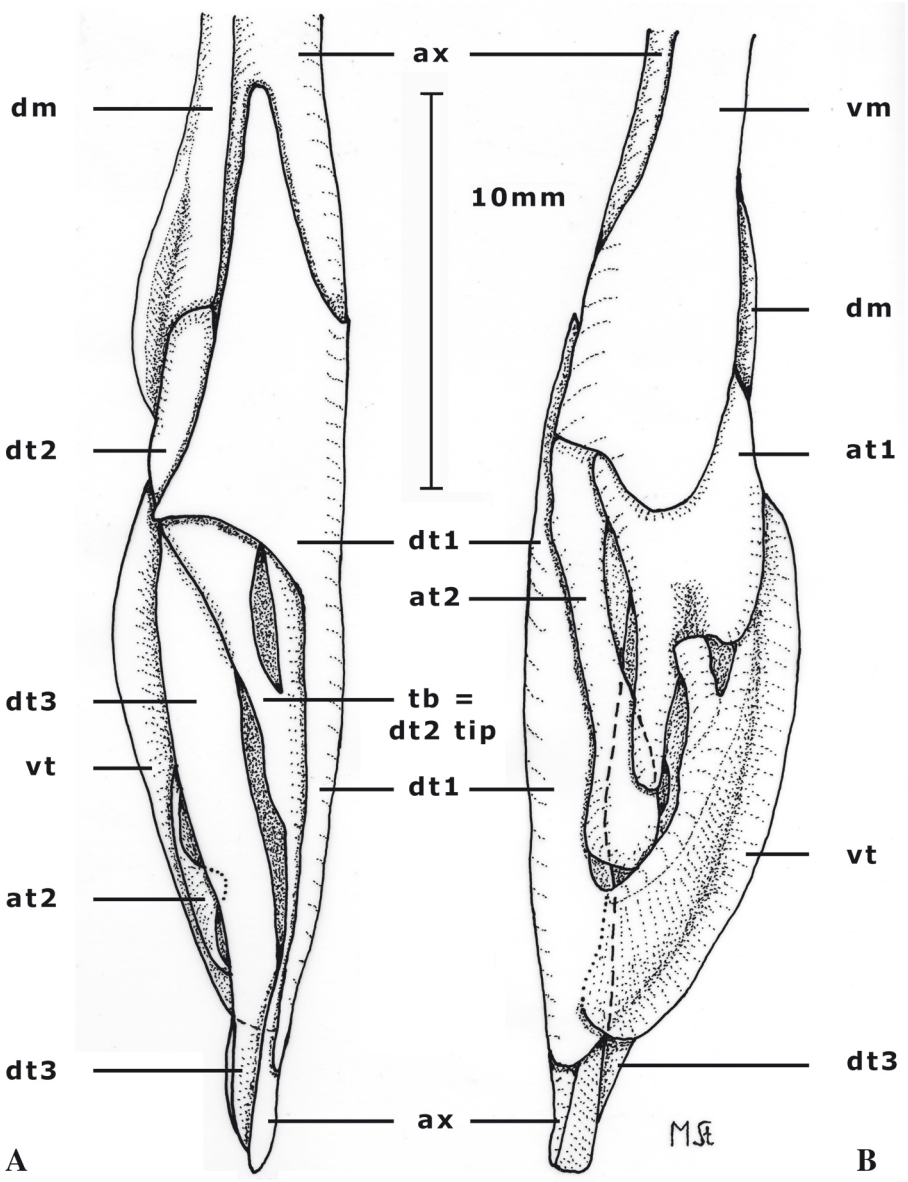

Figure 9. - *Neoraja iberica* n. sp., 318 mm TL mature male paratype ZMH 25429, left clasper skeleton in dorsal (**A**) and ventral (**B**) views. Abbreviations for cartilages: at1-at2 = accessory terminals 1 and 2, ax = axial, dm = dorsal marginal, dt1-dt2-dt3 = dorsal terminals 1, 2, 3 resp., tb = terminal bridge, vm = ventral marginal, vt = ventral terminal. *[Vues dorsale (**A**) et ventrale (**B**) du squelette du ptérygopode gauche. Abréviations pour les cartilages : at1-at2 = accessory terminals 1 and 2, ax = axial, dm = dorsal marginal, dt1-dt2-dt3 = dorsal terminals 1, 2, 3 resp., tb = terminal bridge, vm = ventral marginal, vt = ventral terminal.]*

Clasper components (Fig. 5). - Clasper with very elongated but narrow and shallow pseudosiphon (ps) along entire stem section of outer dorsal lobes from about level of apopyle to begin of terminal region (Fig. 5), but ps formed entirely by dorsal dilatator muscle without direct relation to and not formed by the dorsal terminal 1 cartilage of the clasper skeleton. Inner dorsal lobe with deep longitudinal proximal and shallower distal cleft (cf), separated diagonally by terminal bridge (tb). Proximally, integumental slit (sl) spans between axial and dt1-cartilages over and across upper end of the proximal cleft. A new component 'ribbon' (rb) is defined here: integumental ribbon-like fold located very proximally along midline of glans clasper, originating at base of inner dorsal lobe about level with slit (sl), running diagonally across axial into clasper groove and terminating level with about half length of proximal cleft. Predominant component on inner ventral lobe is the elongated trough-like shield (sh) over nearly entire length of terminal region, with a cutting outer edge of free cartilage and an inward curving dike (di) as a plate-like extension at inner distal end, whereas distal extension as funnel (fn) is poorly developed. Along the proximal inner wall of ventral lobe and to proximal end of shield stretches the rhipidion (rh), an integumental fold with porous outer surface. From underneath proximal end of shield extends diagonally inward a short, finger-like sentinel (st) to half length of terminal region, and originating underneath shield and tip of sentinel curves up a spoon-shaped spike (sp) transversally into the opened glans. Only four among eight mature males showed distally on axial cartilage the rather rudimentary integumental component 'flag'

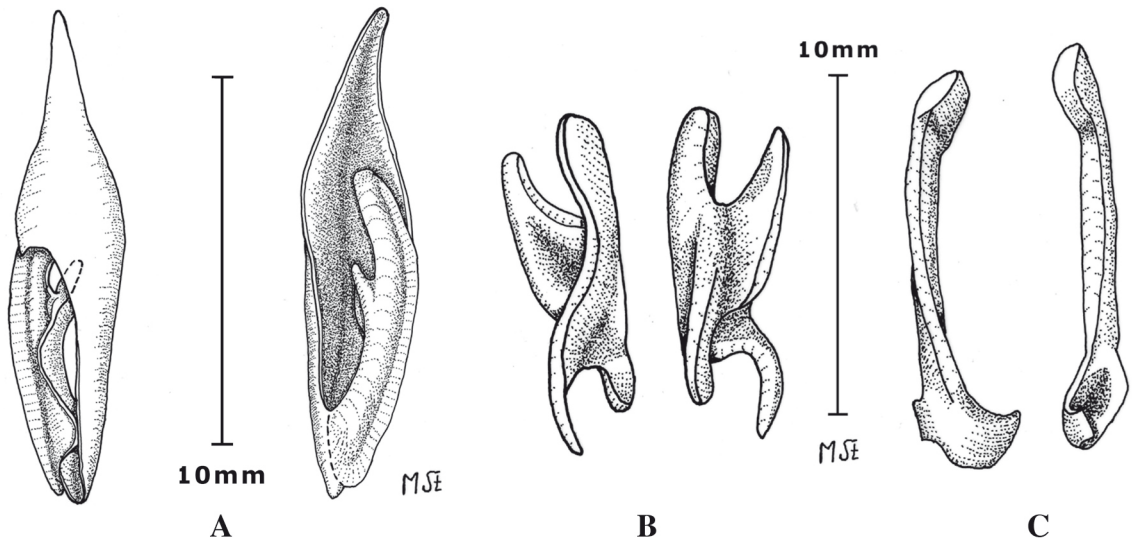

Figure 10. - *Neoraja iberica* n. sp., 318 mm TL mature male paratype ZMH 25429, individual cartilages of left clasper in dorsal and ventral views (left and right, resp.): distally fused dorsal terminal 1 and ventral terminal cartilages (**A**), accessory terminal 1 (**B**) and at2 (**C**) cartilages. *[Cartilages du ptérygopode gauche en vues dorsale et ventrale (à gauche et à droite respectivement) : cartilages dorsal terminal 1 et ventral terminal fusionnés à leur extrémité (**A**), accessory terminal 1 (**B**) et at2 (**C**).]*

Table V. - *Neoraja iberica* n. sp.; pelvis morphometrics of the holotype (X-ray), a juvenile paratype couple (dissected and X-rays) and three more paratypes (X-rays), and relation max. width shoulder girdle / pelvis. (*: From level of max. width / from level of ant. contour. **: From level of max. width). *[Caractères morphométriques de la ceinture pelvienne de l'holotype (d'après radiographies), d'un couple de paratypes juvéniles (disséqués et radiographiés) et de trois autres paratypes (d'après radiographies), et relation entre les largeurs maximales des ceintures pectorale et pelvienne (* : Du niveau de la largeur maximale / depuis le niveau du contour antérieur. ** : Depuis le niveau de la largeur maximale).]*

Specimen	ZMH 25427		ZMH 25428		MB 4869 holotype	ZMH 25431	ZMH 25434	ZMH 25429
Sex and maturity	Immature female		Immature male		mature male	imm. female	mature female	mature male
TL / DW in mm	230 / 118		252 / 127		322 / 170	191 / 98	316 / 171	318 / 168
	Dissected	X-ray	Dissected	X-ray	X-ray	X-ray	X-ray	X-ray
Pelvis max. width	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
Median transverse thickness	13.8	13.9	13.6	11.4	10.6	11.8	13.1	13.4
Prepelvic processes length *	25.6 /9.2	19.8/8.9	tips broken	19.1/5.0	18.4/5.7	14.1/2.9	15.6/4.7	17.0/7.6
Iliac processes length**	19.0	18.3	23.3	15.0	10.6	5.9	15.6	14.5
Depth posterior arc	13.8	14.4	13.1	15.9	13.1	8.8	11.3	17.0
Number iliac foramina	2		2		2	2	2	2
Shoulder girdle max. width, mm		26.0		26.5	29.7	22.0	41.5	31.0
Pelvis max. width, mm	19.5	20.2	20.6	22.0	28.2	17.0	32.0	27.6
Relation shoulder girdle / pelvis max. width		**1.3**		**1.2**	**1.1**	**1.3**	**1.3**	**1.1**

(MNCN 259.163, MNHN 2007-0017, ZMH 25437, MNHN 2007-0017) not present in glans clasper of holotype and a paratype illustrated here.

Internal meristics. - Vtr: 24, Vprd: 71, P radials: 64/64, V radials: 19/19 (Tab. II).

Skeletal anatomy. - Proportional measurements of skeletal elements given in tables III-V.

Clasper (Figs 8-10). - Both marginal cartilages do not possess any extended distal process. The large dt1 with pointed proximal process, and with long distal extension curving around the axial to the ventral side, where firmly fused with the distal tip of the large vt cartilage; plate-like elongated dt2 and dt3 cartilages connect distal end of dorsal marginal with tip of axial cartilage, with the distal part of dt2 forming terminal bridge by connecting to the axial at half length of terminal region; ventrally, the elongate ventral terminal forms the outer edge, and it is linked with its medial process with the medio-distal notch of the U-shaped at1, which itself is attached with its proximal notch around the outer 2/3 of the ventral marginal; at the inner end of the vm attaches the elongated, club-shaped aT2. Figure 10 provides enlarged the isolated relevant cartilages, namely the distally fused dt1 and vt, with the latter's outer lamella forming externally the component shield, and with the inward curv-

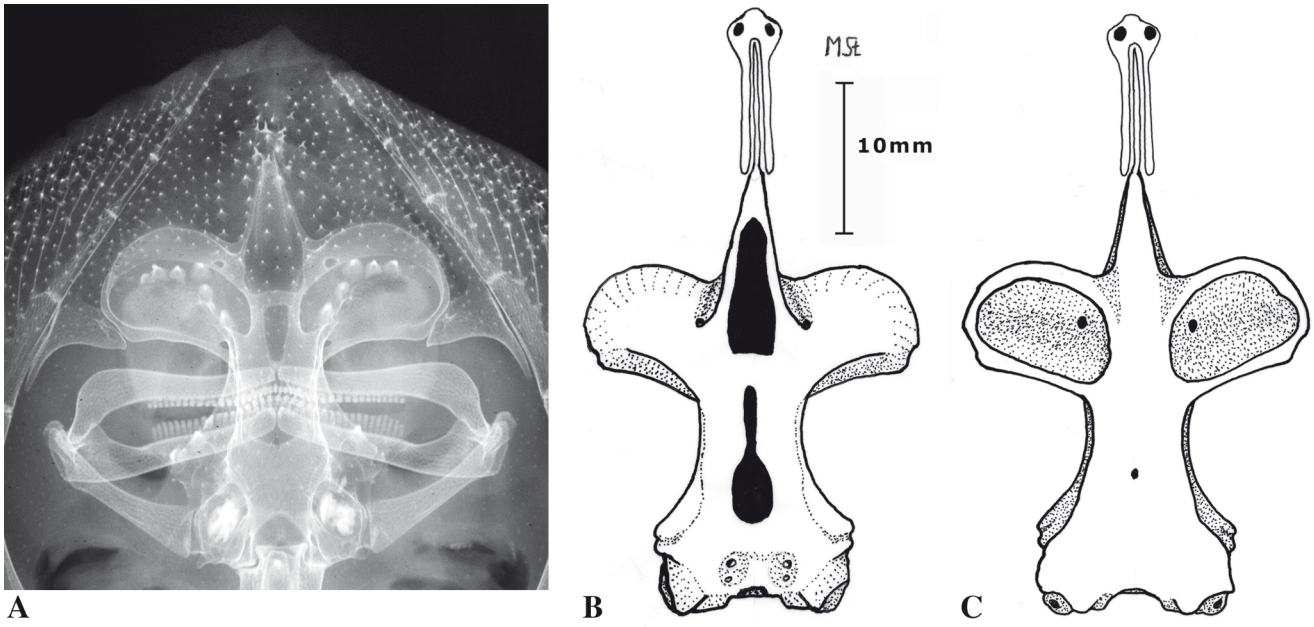

Figure 11. - *Neoraja iberica* n. sp., X-ray of cranium of 322 mm TL mature male holotype (MB 4869) (**A**) and dissected cranium of 230 mm TL juv. female paratype (ZMH 25427) in dorsal (**B**) and ventral (**C**) views. *[Radiographie du crâne de l'holotype, mâle adulte (**A**) et crâne disséqué du paratype, femelle juvénile, en vues dorsale (**B**) et ventrale (**C**).]*

ing process near distal end the component dike, whereas an extension as funnel at distal end is rudimentary; further forms the U-shaped at1 with its distal process external component sentinel, and the club-shaped at2 is the external component spike with its spoon-shaped curved distal end.

Cranium of holotype from X-ray (Fig. 11A; Tab. III). - Rostral base forms moderately broad triangle, base width 18.1% of maximum cranial width; rostral cartilage tapers abruptly at about 2/3 of length to thread-like, non-calcified rostral filament extending to near rostral node. Anterior cranial fontanelle forms elongated narrow triangle with rounded anterior and straight transverse posterior margins; its length 36.6%, its maximum width 16.9% of cranial width. Posterior cranial fontanelle long and club-shaped, with the posterior part being much wider; its length 1.1 times that of anterior fontanelle and 40.6% of cranial width. Fontanelles separated by solid, broad cartilaginous bridge. Nasal capsules very large, with bulging anterior, straight to weakly concave posterior margins and marked preorbital processes; capsules slightly angled forward at 79° to longitudinal axis of cranium. Nasobasal fenestrae absent. Orbital region long, strongly constricted as evenly deep arc; minimum interorbital width dorsally 27.2% of maximum cranial width. Minimum width of basal plate and internasal space 22.2% and 14.1% of cranial width, resp. Otic region relatively long and wide, postorbital processes well marked and separated by notch from smaller pterotic processes. Jugal arches small and delicate, not exceeding contours of occiput. Rostral node thin and plate-like, with two large perforations, and long, thin appendices not fused with rostral shaft; length of appendices about 43% of rostral length.

Scapulocoracoid (Fig. 12; Tab. IV). - One large, vertically to somewhat diagonally oval anterior fenestra is situated nearly completely in the dorsal part of the element above a horizontal line through all three condyles. Post-mesocondyle length of the element is only a bit larger than pre-mesocondyle length, except for the left element of the immature male (ZMH 25428) with a little longer pre-msc-section. A moderately large to very large, more or less horizontally oval postdorsal and postventral fenestra close to horizontal midline, resp. In the female (Fig. 12A), the scapulocoracoid shows a rectangular, rather low overall shape with angular contours, with maximum length being 1.6 times the height at rear corner; the dorsal margin is horizontally concave, with very well marked angular rear corner, the postdorsal margin slopes steeply to metacondyle, as well as the postventral margin from this condyle; ventral margin horizontally nearly straight. In its left element both, postdorsal and postventral fenestrae are equally rather small and of the same size, their length is 87.5 and 100.0%, resp., of that of the anterior fenestra; in its right element, however, pdf and pvf are almost twice as large as in the left element and their length is 111.0 and 105.6% of the af, resp. In the male (Fig. 12B), the element rather displays a more compact, relatively higher and ovoid overall shape with rounded contours, with maximum length being 1.8 times the height at rear corner; dorsal margin is more or less horizontally straight to weakly concave, the rear corner widely angled to rounded but not sharply angular, and postdorsal margin slopes at about 45° angle diagonally to metacondyle, as also does the postventral mar-

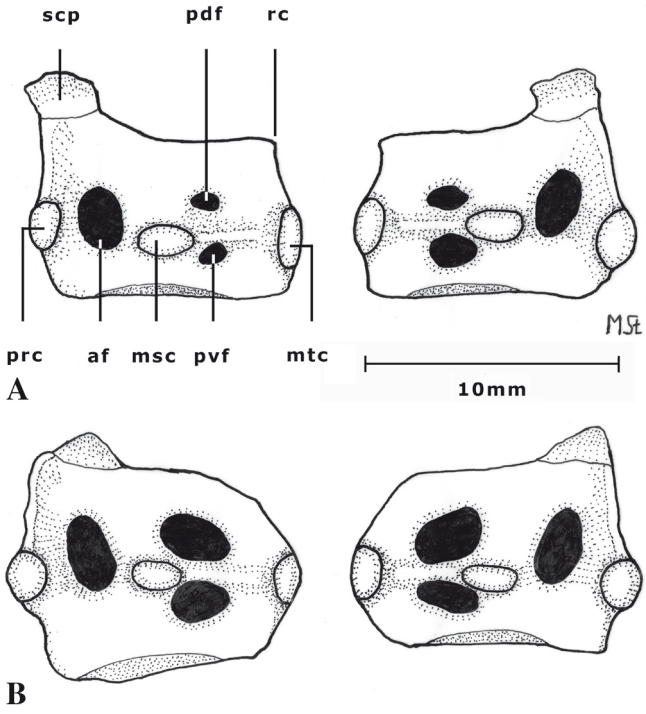

Figure 12. - *Neoraja iberica* n. sp., left and right scapulocoracoids of 230 mm juv. female (ZMH 25427) (**A**) and 252 mm TL juv. male (ZMH 25428) (**B**) paratypes in lateral views. Abbreviations: af = anterior fenestra, msc = mesocondyle, mtc = metacondyle, pdf = postdorsal fenestra, prc = procondyle, pvf = postventral fenestra, rc = rear corner, scp = scapular process. *[Scapulocoracoïdes gauches et droits des paratypes, femelle juvénile (**A**) et mâle juvénile (**B**), en vue latérale. Abréviations : af = fenestra antérieure, msc = mésocondyle, mtc = métacondyle, pdf = fenestra postdorsale, prc = procondyle, pvf = fenestra postventrale, rc = angle postérieur, scp = processus scapulaire.]*

gin from mtc, so that the rear contour appears triangular or trapezoid, rather than rectangular as in the female. The large, oval anterior fenestra is equal in size and shape in left and right element, and corresponds well with the af of the female. However both, postdorsal and postventral fenestrae are about twice as large in the male than in the female, and further are both fenestrae different in size and shape in left and right element of the male.

Pelvic girdle of holotype from X-ray (Fig. 13; Tab. V). - Prepelvic processes are very short, solid conical and outward inclined; two obturatorial foramina in each iliac region; pelvic bar weakly angled only, more so in the female (Fig. 13 B); posterior contour an evenly rounded deep arc in the male, with transition to iliac regions as well marked angles, whereas in the female the rounded arc is much shallower, with transition to iliac regions hardly marked. Iliac processes massive and longer in the male than in the female. Proportionally, the female pelvis is apparently wider than that of the male, whose iliac regions also are more massive, as is shown as well by the relation of maximum width of shoulder girdle to that of the pelvis, resp. (Tab. V).

Variation in paratypes

Proportional morphometrics are given in table I as range and mean.

Like in most rajid species, the shape of disc differs in young and females from that of mature males, in that the latter have a strongly undulated anterior disc margin, whereas in young of both sexes and also larger females it is at most weakly undulated to evenly convex. As a rule the bases of dorsal fins are confluent in this species, but exceptionally do specimens show a more or less distinct interspace separating both dorsals. Only four immature males (ZMH 25428, MNHN 2007-0014, MB 4873c, ZMH 25433) among the Portuguese samples and only one male (MNCN 259.159) among the new Spanish samples had dorsal fins separated. As is demonstrated by the values in table I, there is no obvious sexual dimorphism in proportional morphometrics, and values present in general only a moderate range.

There is little variation in shape and density of dermal denticles on dorsal surface of disc, posterior pelvic lobes, on eyes, tail and on dorsal and upper caudal fins. All specimens are smooth ventrally, except for prickles along the extreme outer edges of the tail. Sides of tail in small juveniles possess only one to two irregular rows of enlarged thornlets. In all specimens, the median row of thorns begins directly posterior to shoulder girdle, or at most on anterior trunk, and appears more regular in young in shape of and distance between thorns. However, from smallest specimens onward, median thorns become rapidly much smaller from about half tail length to D1, to become very insignificant, irregularly spaced and seemingly disappearing with growth. The drastic reduction of median thorns in posterior half to one third of tail is a natural condition and does neither display a late development of thorns in this section with growth, nor a reduction or absorption of existing normal thorns as specimens grow. Thus there is some variation in number of median thorns in small and large specimens. Likewise is some variation displayed in number of orbital, nuchal and scapular thorns, as these appear to be replaced rather often and so vary in number and shape. Also scars are present where thorns have been lost, and have been counted especially in the median row series.

Preorbital thorns of different developmental stages were found in a patch of 2-8, mostly 4-6, on each side. Supraorbitally usually no thorns but a gap separating pre- and postorbital thorns, only very exceptionally may a small supraorbital thorn appear. Postorbital thorns, again differing in development, were found in the range of 2-5, mostly 2-4, each side. Only in about 50% of the specimens was a small supraspiracular thorn present on each side, but regularly was found a pair of small, conical interspiracular thorns with a very few exceptions. Thorns along midline of nape are mostly large and appear in the range of 2-7, mostly 4, with the maximum numbers resulting from few cases with paired thorns anteriorly,

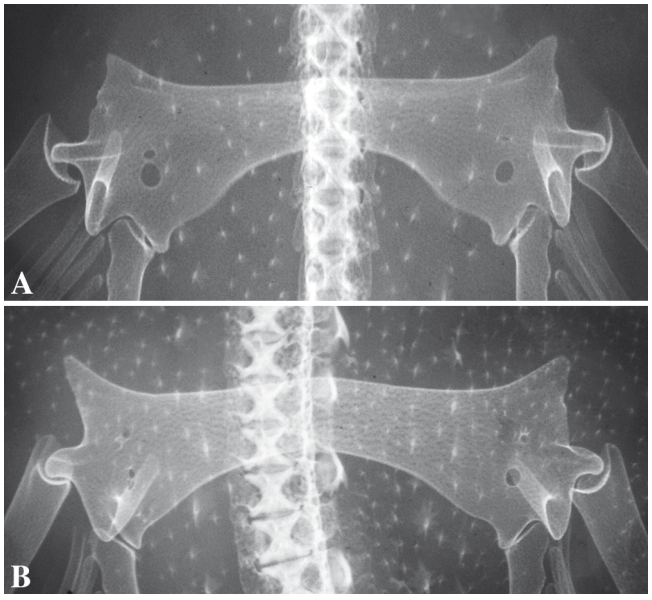

Figure 13. - *Neoraja iberica* n. sp., X-rays of pelvic girdles in dorsal views of 322 mm TL mature male holotype (MB 4869) (**A**) and juv. female of 262 mm TL (TCWC 13204.01) paratype (**B**). [*Radiographies en vue dorsale des ceintures pelviennes de l'holotype mâle adulte (**A**) et du paratype femelle juvénile (**B**).]*

and in one specimen was also a pair of smaller lateral nuchal thorns present. On mid-shoulder mostly a single thorn, but in one third of specimens a second one located usually over rear edge of shoulder girdle. Thorns on shoulders vary from 0-4 on each side, often differing on both sides in number and also in arrangement, i.e. side by side, or in triangular position, but mostly were only one or two thorns found on each shoulder. Median thorns from anterior trunk to level of pectoral axils, mostly in rather regular line and at equally short interspaces, numbered 7-17, mainly in the range of 10-15. Much greater range is shown in number of median tail thorns for reasons mentioned above, with extremes from 25 to about 60, if obvious scars and very tiny thorns in posterior half of tail to D1 are included; about 35-40 is the most frequent count, which however all rather relative due to the uncertainty with counting the tiny median thorns along posterior half of tail. Apparent large thorns from posterior to shoulder girdle to about midlength of tail are in the range of 28-51.

Most obvious is in this species the change in dorsal ground colour from ochre-brown in young to rather medium greyish-brown in larger specimens, along with lively colour pattern in young fading toward mature stages. Figures 2A and 6A show the regular appearance in adult males and females, i.e. of the lively ornamentation of juveniles and half-grown ones remain one or a few pairs of the larger dark spots and eventually one or two pairs of the pale or whitish dots, or specimens may even appear nearly plain brownish. Figure 7 shows the dorsal appearance of small juvenile specimens MB 4873b and ZMH 25432, namely the disc, incl. rostral area and eyeballs, and posterior pelvic lobes are scattered to the extreme outer edges with dark brown oval to circular dots and spots, and of the latter several symmetrical pairs on inner parts of both pectorals are larger and pale edged; mostly two pairs of circular whitish spots are found on inner pectorals level with posterior nape (the larger) and level with posterior trunk (the smaller), and although fading with growth these do often also remain in larger specimens. Occasionally are nuchal and scapular thorns pigmented dark, and few specimens showed a dark transverse bar over shoulder girdle, including the darkly pigmented thorns, and others display dark edging at pectoral axils and/or a dark blotch on pelvic origin. Further are the usually eight blackish-brown cross-bars or somewhat asymmetrically paired saddle blotches along tail more apparent in small specimens. The white underside of disc displays seemingly in smaller specimens with very thin disc margins dark spots and dots, which however are translucent from the dorsal pattern. The intensity of the broad greyish margin to outer disc corners and posterior margins, as well as that to posterior pelvic lobes, varies but becomes indistinct rather in larger specimens. Further variation is shown by the appearance in several specimens (e.g., in the holotype and paratype female ZMH 25434, see Figs 2B, 6B) of variously large clouds on inner ventral pectorals of more or less distinct medium brown spots merging to various degrees.

Internal meristics. - Vtr: 21-26, Vprd: 67-74, P-radials: 60-69, V-radials: 15-20 (Tab. II).

Size

Min.-max. sizes of the material are 55 (neonate)-327 mm TL, with 327 mm for the largest male and 316 mm TL for the largest female; largest adolescent male was 278 mm, smallest mature male was 295 mm TL. Males appear to mature between about 280-290 mm TL.

Distribution (Fig. 1)

Upper slope of southern Iberian Peninsula within Bay of Cadiz at 270-670 m depth. One oblique haul from 172-414 m (ZMH 25427) presumably took the specimen at the deeper part of the haul. Bottom temperature and salinity, if taken, at capture stations were approximately between 12.76 and 13.95°C and 36.18 and 37.20 psu, resp., according to data obtained by J. Baro. Regarding bottom substrate, which was not specifically registered during trawl operations, J. Baro's colleague V. Diaz del Rio provided the following summary for the general condition: "Sediments become progressively finer-grained with increasing depth of water and distance from the sea shore. On the upper slope, there is a strong dominance of contourite deposits composed of fine and very fine, occasionally muddy, sands created by the contour-flowing of the strong outflow current of Mediterranean water through the Strait of Gibraltar".

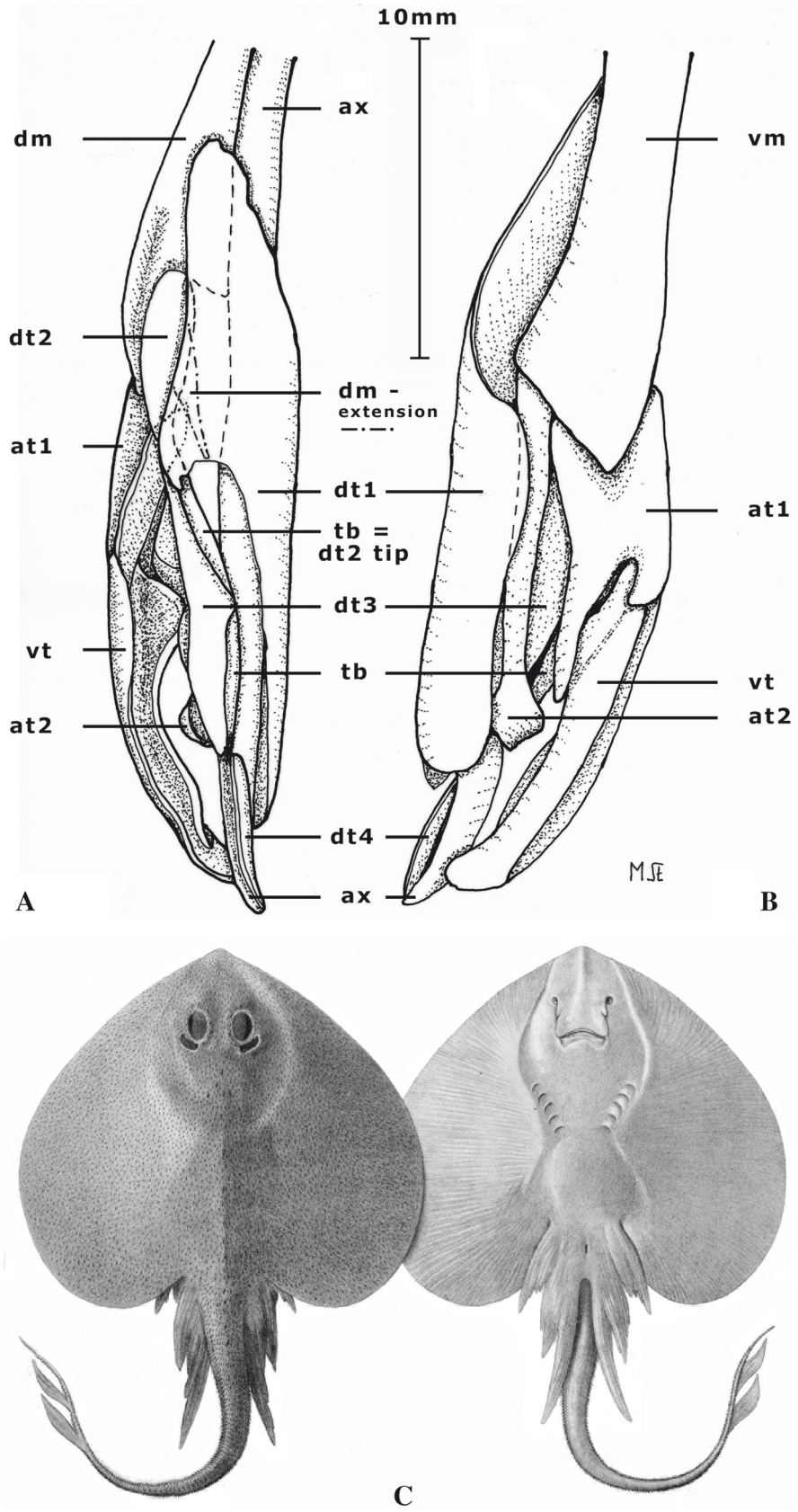

Figure 14. - *Raja fullonica* of Vaillant (1888) (non Linnaeus); mature male about 260 mm TL (MNHN 83-149) = *Neoraja* sp.; skeletonised left clasper in dorsal (**A**) and ventral (**B**) views. Abbreviations as in figure 9; plus dt4 = dorsal terminal 4. Vaillant's original plate 4 illustrations (**C**) of this specimen. *[Mâle adulte d'environ 260 mm LT =* Neoraja *sp. ; vues dorsale (**A**) et ventrale (**B**) du ptérygopode gauche décharné avec son squelette apparent. Abréviations : voir la figure 9 ; plus : dt4 = dorsal terminal 4. Planche 4 originale de Vaillant illustrant ce spécimen (**C**).]*

Etymology

Named for the type localities which are a very restricted area of the eastern North Atlantic along south-western slope of the Iberian Peninsula, in both the Portuguese and Spanish sectors.

Interspecific comparison

N. iberica is already clearly distinguished from its four congeners by its relatively light ochre to medium greyish-brown dorsal ground colour (*vs* plain dark ground colour, or bluish in *N. caerulea*) and by its pattern of largely symmetrically arranged dark brown dots and spots plus a few pairs of small whitish spots on pectorals and posterior pelvic lobes (*vs* no dorsal colour pattern at all). *N. iberica* has an almost totally white underside with at most faint greyish broad margins to outer corners and posterior pectoral margins, as well as to posterior pelvic lobes, and as a rule is its underside of tail plain white. The four congeners, in contrast, show distinctly dark to even blackish broad margins ventrally at least at outer corners and along posterior pectorals, as well as to posterior pelvic margins, and hardly ever a plain white underside of tail. Head and the centre of disc ventrally are usually plain white in *N. iberica*, with at most a cloudy blotch of pale brown, partly merging spots on inner pectoral centres in few specimens. In contrast, as a rule congeners display more or less large dark areas also on underside of head, interbranchially, along line of gills slits, on belly and inner pectorals to at times almost totally dark discs, as well as their underside of tail is always marbled light and dark, largely blotched dark, or even totally dark in anterior half or two thirds of length.

The four congeners resemble each other and *N. iberica* in further external aspects like: general shape, squamation and even morphometric proportions, tooth row counts and internal meristics (Vtr, Vprd, P and V radials), as well as their scapulocoracoids and pelvic girdles are very similar, as largely demonstrated by McEachran and Compagno (1982). Even claspers, except for *N. carolinensis* with no mature males yet known, show externally and in their skeleton a very similar aspect, in that outer surfaces display a rather intensive coverage of fine dermal denticles, and the 'pseudosiphon' groove on outer dorsal lobe is either lacking (*N. stehmanni*, *N. caerulea*), or present but formed as a longitudinal, very proximally located groove largely (*N. africana*) or totally (*N. iberica*) within the dorsal dilatator muscle. All congeners with mature males known show externally and in their clasper skeleton the component 'terminal bridge' separating two distinct 'clefts' on inner dorsal lobe (not labelled by Hulley, 1972, Fig. 4, as neither external components 'dike' and 'funnel', but likely present according to skeleton Fig. 5), and the lateral 'dike' and distal 'funnel' extensions of ventral terminal cartilage in its distal third. The large clasper cartilages dorsal terminal 1 and ventral terminal – each of characteristic shape, and dt1 curving around axial distally – are firmly fused with their distal tips on inner ventral side, with (*N. stehmanni*, *N. africana*, *N. iberica* but rudimentary in the latter) or without (*N. caerulea*) distal extension of vt forming external component 'funnel', depending on whether the dt1 or the vt is the longer element at distal fusion, and if the vt shows a more or less distinct distal extension. Further differences are due to presence (*N. stehmanni*, *N. africana*) or absence (*N. caerulea*, *N. iberica*) of a distal extension of the dorsal marginal cartilage and so a more or less distinct external component 'pseudorhipidion'. The accessory terminal 1 and 2 cartilages are in all species, with mature males known, of genus-typical U-shape, with Z-shaped distal lateral extension, or straight club-shaped with spatulate, curved tip, respectively. The number of dorsal terminal cartilages, other than dt1, may vary from mostly three (*N. stehmanni*, *caerulea*, *iberica*) to four (*N. africana*) as a sequence connecting as dorsal lobe support the distal end of dorsal marginal with the terminal bridge to the axial and the very tip of the axial cartilage. To a degree, presence or absence, or distinctiveness of external components supported by cartilages, as well as clasper cartilages themselves may depend on age of a mature male specimen, in that continued growth of cartilage extensions and the increasing degree of skeletal calcification may make up some of the interspecific differences. This may also hold true for integumental components in the glans, as was found in *N. iberica*. Of eight mature males, only three (MNCN 259.163, MNHN 2007-0017, ZMH 25437) showed a rudimentary component flag (fg) in both claspers as a low integumental flap on distal end of the axial cartilage, but a flag showed only in the right glans clasper of MNHN 2007-0017. Such natural variation demonstrates the apparent gradual development of the flag, if it shows at all?, as mature males grow larger and become older.

Based on the revision by McEachran and Compagno (1982) and availability of better species specific information, a final conclusion can now be drawn regarding the generic identity of the *Breviraja* sp. (*Raja fullonica* of Vaillant, 1888, non Linnaeus; Fig. 14C) as mentioned and commented on in CLOFNAM (Stehmann, 1973 and 1979 [Suppl.]) and in FNAM (Stehmann and Bürkel, 1984), which appears to have been taken at 614 m depth on the continental slope off northern Spain, i.e. in the southern Bay of Biscay. This single, badly disintegrated, partly skeletonised mature male of approximately 260 mm TL (MNHN 83-149) has been re-investigated to the still possible details by the senior author, incl. radiographs. It can be assigned now to the genus *Neoraja*, based on mainly the following features: cranium without nasobasal fenestrae and with obviously broad basal rostral triangle narrowing abruptly to a delicate rostral shaft being disintegrated like rostral node and its appendices, but with anterior propterygia and pectoral radials apparently extending forward to nearly snout tip. Totally skeletonised claspers,

no more providing any indication of integumental components in the terminal region, do however show all *Neoraja*-typical features of the terminal skeleton (Figs 14A, 14B): large dt1 with proximal extension and distally curving around axial onto ventral surface; elongated vt with anterior notch and medial extension linking with ventral surface of at1 but distally (? no more due to disintegration) not fused to and longer than dt1, further with distal, inner dorsal plate-like, upward curving extension (dike); dt2 to dt4 sequence of dorsal terminal cartilages linking distal end of dm, which has an outer distal extension (pseudorhipidion), with tip of axial, and dt2 with its distal end fused with axial (terminal bridge) and head of dt3; at1 and at2 typically of U-shape with Z-shaped lateral extension and club-shape with spatulate tip, respectively. Internal meristics fall well into the range for congeners: Vtr 25, Vprd 73, P radials approximately 65, and tooth rows approximately 40 in each jaw. Further external characters also fit well the generic diagnosis: individual thorns but no thorn triangle on nape/shoulder region (2 median nuchal, none suprascapular, probably one on each shoulder) and about six small orbital thorns each side; from directly posterior to shoulder girdle one median row of about 50 thorns to D1 (10 on trunk, about 39 on tail) but almost disappearing after two thirds of tail length a fair distance in front of D1. Upper side totally spinulose. Lateral tail folds only in posterior third of tail length.

However, several distinct features distinguish this *Neoraja* sp. from its five congeners: disc of this mature male very evenly inverse heart-shaped, without obvious undulation of anterior margins as is typical in mature males (correctness of pl. 4 in Vaillant, 1888, assumed); colour (in present bad condition and preserved) dorsally and ventrally sort of plain medium brown, without any indication or remains of dorsal colour pattern; dorsal fins widely separated by space of about two times D1 base length, both very short-based and fan-shaped much higher than long, with probably interdorsal thorns between both; this mature male shows a strikingly long postdorsal tail section, which is about twice as long as the distance from D1 origin to D2 base end, bearing a long, low epichordal C lobe terminating a bit anterior to tip of tail.

If the locality in the southern Bay of Biscay at a depth of 614 m has been interpreted correctly, it is surprising that no additional specimens have been discovered. Hence doubts remain concerning the locality of the specimen. The poor condition of the specimen also recommends to not yet formally name this species

DISCUSSION

One may wonder, why *N. iberica* has been only recently discovered, although European slope waters are among the best investigated for a long time, and this moderately rare species lives at upper to middle slope depths having been commercially fished on the bottom for fish and crustaceans again for a long time by local fishermen. The very small size of this pygmy skate species may mainly be responsible, that is has been overlooked probably and/or been discarded at sea or mistaken on a first glance for juveniles of not marketable size of one of the well know, larger growing skate species landed regularly for human consumption. Its very small size eventually also prevented its being caught by trawls, or made it easier for specimens to escape from a trawl. Such circumstances may also have delayed the discovery of *N. caerulea* within the Rockall Trough to the west of Scotland and Ireland until the 1970s, despite its exceptional blue dorsal colour making it indeed obvious in any catch, in particular because commercial deep water fishing there has been carried out by large factory stern trawlers using trawls with large mesh size – unlike the small local fishing boats along the Iberian Peninsula south coast.

Species of the genus *Neoraja* show at least in the Eastern Atlantic mostly an unusually localized, very limited distribution not only compared with other offshore deep water but likewise shelf species of skates. However, their small size is an apparent reason for them being unable to migrate over long distance, and they may have occupied particular ecological niches within their restricted habitat areas, where they have been found living sympatrically with larger species of other deep water skates. Knowledge of their biology is still too limited for confirming the latter assumption. According to Compagno *et al.* (1991) is *N. stehmanni* an endemic off the west coast of South Africa from mainly about Saldanha Bay to south of Agulhas Bank, with so far only one more northern record south west of Orange River mouth at 292-1025 m depth. It is said (*loc. cit.*) to have been caught in considerable numbers of mostly adults off Cape Town and Saldanha Bay in limited areas below 600 m depth. *N. caerulea* has only been found at about 600-1260 m depth within the Rockall Trough to the west of Scotland and Ireland on the continental slope and slopes of surrounding submarine banks, with occasional records also on the outer slopes of the latter banks delimiting the Trough to the north and west. Bottom water temperatures at capture localities were between 6.41° and 9.102°C, mostly between 6.4° and 6.9°C, and salinities between 35.171 psu and 35.326 psu. The species thus appears to live within the NE Atlantic water mass characterised by temperatures higher than 6°C and salinity of more than 35 psu. If this holds true, the depth range of *N. caerulea* will be limited to a maximum of about 1300 m (Stehmann, 1976; Stehmann and Bürkel, 1984). *N. africana* was so far found with three type specimens on the Central West African continental slope off Gabon at 900-1030 m and 4.35° to 4.66°C (Stehmann and Séret, 1983) and with one postembryonic female off Mauritania/Rio de Oro at 1490-1640 m depth (Stehmann, 1995). With these

two widely separated localities and apparently greater depth range, *N. africana* shows a wider geographical distribution within the Eastern Atlantic than its congeners. *N. iberica* with its very limited distribution, eventually sharply restricted by the outflow of high salinity Mediterranean water through the Strait of Gibraltar, is geographically intermediate between *N. africana* and *N. caerulea*, and the *Neoraja* sp. of Vaillant (1888) from off the north coast of Spain – correctness of its locality given – is intermediate between *N. iberica* and *N. caerulea*. The only NW Atlantic congener, *N. carolinensis*, was found with all but one of six type specimens off North Carolina at 695-1010 m, 4.18-4.56°C and 34.929-34.958 psu, only one paratype off Florida at 1000-1008 m, 6.09°C and 35.035 psu (McEachran and Stehmann, 1984).

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